STUDY OF THE MARINE FAUNA OF THE KARWAR COAST AND NEIGHBOURING ISLANDS

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PART II: MOLLUSCA—AMPHINEURA AND GASTROPODA

(*Continued from p.* 139 *of this volume*)

INTRODUCTION

The present paper is the second of a series of papers devoted to the systematic study of the marine fauna of the Karwar Coast and neighbouring islands. The Karwar Coast is especially rich in the molluscan fauna and hence it was thought desirable to deal with only Amphineura and Gastropoda in the present paper. The remaining groups of Mollusca will be dealt in a subsequent paper.

SYSTEMATICS

MOLLUSCA

Mollusca are the most abundant of all the animals found in the littoral regions of Karwar. A large variety of them have been collected from all the different localities, either in the living condition or as empty shells. The oysters and clams are by far the commonest of the molluscs of Karwar and they form a major part of the food of the coastal population.

Representatives from all the major classes of the phylum have been recorded except members of the group Solenogastres.

PLACOPHORA:

Chitons have not been observed in appreciable numbers. The only genus recorded is *Acanthochitona* found on the rocks between tide marks in Kamat's bay, Binge bay and Kurmugad island. These animals are recognised by the presence of bundles of spicules along the edge of the mantle, arranged in tufts.

GASTROPODA:

Gastropods are very well represented all along the coast and the live animals recorded are as numerous as the empty shells collected. The following are the families recorded:

Patellidae:

Limpets are quite abundant in Karwar and are found living between tide marks on rocky coasts. They live so near the high tide mark, that during low tide they are left stranded high and dry. Though edible,

they are not used as food along this coast. However, some people in Anjadiv island have been seen collecting them for food. The following three species are the most common in Karwar: *Patella variabilis* (Sowerby), *P. reynaudi* (Deshayes) and *P. nimbus* (Reeve).

Haliotidae:

The Ear-shells are flat, oval and limpet-like, with a row of holes on the outer posterior margin of the shell, the anterior ones being closed. A low indistinct spire is recognised at the anterior end. Only a few dry shells of *Haliotes varia* (Linnaeus) have been collected.

Fissurellidae:

As these animals live below or at the low tide mark, the majority of them are seen only as shells washed ashore.

Clypidina notata (Linnaeus) is the most common Fissurellid of Karwar and is found in large numbers along with the true limpets, but generally at a lower level. Its shell is conical and violet in colour with deep ribs and narrow white grooves radiating from the apex. The shell has no hole or slit and may be mistaken for that of *Patella*. Its fissurellid characters are revealed only by the study of the internal anatomy.

Diodora has a smaller, but more elongated brownish shell with a slit at the apex. They live below the low tide level and only dry shells washed ashore have been collected.

Emarginula has a thinner and more flat shell with a slit at the posterior margin. They too are known only by the dry shells that have been washed ashore.

Scutus is again known only by the dry shells washed ashore and is similar to *Emarginula*, but is thinner, narrower, longer and has no slit. Its front margin is slightly concave.

Trochidae:

The Trochidae found in Karwar are quite small in size and are found on rocks between tide marks. Five representatives of this family are known.

Trochus is the most common and has a bigger shell with red and brown markings. Both empty shells and live animals have been collected.

Calliostoma has a shell similar to *Trochus* in shape, but is delicate and shows a sharply pointed apex. Only empty shells have been collected.

Euchelus has a shell smaller than *Trochus* and its whorls are bulged. Both live animals and empty shells are known.

Umbonium is small, half an inch or less in diameter, and has a shell with a very low cone. The shell is polished and brightly coloured. They are found in large numbers in the extensive sandy areas, which are submerged during high tide.

Minolia has a slightly larger shell with a higher spire and bigger aperture than *Umbonium*. The surface of the shell is sculptured or decorated with spiral ridges. These animals are found living on rocks.

Turbinidae:

Turbo is the only genus represented from this family. The shell has a high spire and swollen whorls arranged like a tapering turban. Its operculum is heavy, calcareous and is shaped like a plano-convex lens. The animals are collected from the rocks and many a time the opercula are seen washed ashore in good numbers.

Neritidae:

Nerita are found in large numbers on the rocks. They have a heavy swollen shell with a low spire and no umbilicus. A very closely allied form with a similar, but smaller and thinner shell, is *Neritina*, which is found in the estuary, while *Nerita* is exclusively marine. *Neritina* is found in large numbers on the mud-banks of the river Kalinadi. A series of transitional forms, ranging from the very highly saline to the very pure freshwater regions are represented by this genus.

Architectonidae:

Architectonica has a shell with a wide low cone and an open umbilicus, the margin of which gives the impression of a spiral staircase, hence the name 'staircase shell'. Only a few empty shells have been collected.

Epitoniidae:

The animals of this family have more or less elongated shells with distinct whorls, and they possess a horny operculum. Animals belonging to the following two genera have been collected in Kamat's Bay.

Epitonium has a shell whose whorls are swollen and encircled by transpiral ribs. Only one live animal was collected on a rock.

Eglisia has a shell with the base of the body whorl flattened and has spiral lines and radial sculpture on it. Only a few empty shells have been collected.

Fasciolariidae:

These animals possess spindle-shaped shells with an elongated anterior canal. The operculum is horny. Two genera are known in Karwar.

Fasciolaria is more or less like the sacred chank, but the anterior canal and the spire are comparatively longer. They live in slightly deep waters and can be collected by dredging.

Fusinus has typically a fusiform or spindle-shaped shell with a very long spire and a long beak, and the whorls are gracefully rounded. The shell is sculptured with longitudinal and transverse striations. These animals were also collected in large numbers by dredging.

Volemidae:

Hemifusus is the knobbed chank, the knobs being very conspicuous. They have a long anterior canal with a comparatively short spire. The shells are very massive and grow to a large size. A few large specimens are usually found in the nets brought to the shore.

Mitridae:

Mitra has a beautiful elongated spindle-shaped shell without an operculum. The surface of the shell is ornamented with coloured spiral lines and spots. A few dry shells have been collected on the beaches.

Buccinidae:

The animals included in this family, commonly known as Whelks, have an oval shell with more or less an oval aperture. The foot is large with a horny operculum.

Babylonia spirata (Linnaeus) has a smooth shell with brown patches on a pale background. The grooves separating the whorls are broad and deep, giving the spire an appearance of a tower with successively decreasing stories. These animals are found in sandy and muddy areas below the low tide mark. They are usually collected by dredging or are brought to the shore in the fishermen's nets.

Engina is quite small with the shell having tuberculated ribs and a very small operculum. The tubercles are brownish in colour on a pale background. These animals are littoral in habitat.

Nassidae:

The animals belonging to this family possess shells with short anterior canals and horny opercula. They have a large and broad foot and a long siphon. Two genera are represented in Karwar.

Nassa has a shell with a large aperture and in the majority of species, the shells have transpiral grooves or lines. They have been collected in Kamat's and Binge bays.

Bullia have thinner shells with taller and more slender spires. They live burrowing in the sand near the low tide level. They have always been found in large numbers in Kamat's Bay. With the receding waves they are often left exposed, when it is common to see them rapidly burrowing into the sand with their large leaf-like foot. When handled, these animals squirt a quantity of water through an aperture in front of the foot and then only can the foot be contracted and withdrawn into the shell. It is interesting to note that, though thousands of these animals are found in live condition all round the year upon this shore, only a few empty shells have been seen cast ashore. The presence of some predacious animal which feeds upon these snails has been suspected.

Muricidae:

The shells of these animals are solidly built and in many species the varices are ornamented with tubercles or spines. The spire of the shell is usually shortened and the body-whorl is large. Their foot is large and the operculum is horny. Three genera, with several species in each, are well represented in Karwar.

Murex is recognised by its long anterior canal and distinct varices. One species, *M. tribulus* (Linnaeus), which bears long slender spines, is occasionally brought ashore in the nets entangled by its spines. Another

species is collected in the muddy areas, which has a thick shell with a moderately long anterior canal and the varices bearing tubercles.

Rapana has a large and thick shell with a spiral line of small tubercles, a large umbilicus and a low spire. It is common on the rocks between tide marks.

Thais shells are thick and generally their longer diameter equals the height of the spire. The whorls are characterised by lines and tubercles. There are several species of *Thais* in Karwar. They are littoral, gregarious and found under or between rocks and stones. Egg-capsules of *Thais* have been found attached in clusters to rocks and many a time to molluscan shells which are washed ashore. Each capsule is about half an inch in length and is shaped like a straw-coloured vase with purple edges.

Cancellariidae:

Cancellaria has a moderate-sized shell with rather small ribs and no operculum. Only one live animal was collected on a rock in Kamat's Bay.

Pyrenidae:

Pyrene have short spindle-shaped solid shells about an inch in length and may be mistaken for the shells of *Engina* (Buccinidae). The *Pyrene* shell has a longer spire, narrower aperture and is more spindle-shaped. It is usually found living along with *Engina*.

Olividae:

The Olives are found actively burrowing into the sand, probably in search of bivalves on which they feed, and a number of them have been collected in Kamat's Bay. The shell is cylindrical in shape, like an olive fruit, with a low spire and a narrow mouth opening. The foot is large with no operculum. The surface of the shell is highly polished and beautifully coloured like marble. There is no periostracum over the shell, because it is normally covered by the expanded foot and mantle, which are responsible for maintaining the polish. Two genera are represented in Karwar.

Oliva has a bigger and heavier shell with a variety of coloured markings.

Ancilla has a comparatively slender shell with uniform colouring, and in one species, *A. ampla* (Gmelin), the shell has a dark brown apex.

Harpidae:

Harpa has an inflated shell with a short spire, beautifully coloured and presenting a number of longitudinal ribs appearing like the strings of a harp; hence the name. A single dry shell was collected on Karwar beach.

Conidae:

Conus, as the name implies, has a cone-shaped shell with a very short spire, almost flat, forming the base of the cone. They have a long and narrow aperture and a claw-shaped operculum. They are

brilliantly coloured and have been collected from Baitkal Cove and Kamat's Bay.

Littorinidae:

Littorina is found all along the coast in Karwar, living in groups of hundreds on rocks and other habitats. Their shells are small, whelk-shaped, but the aperture is rounded at the anterior margin. The foot is divided longitudinally into two halves, each moving alternately forward. The shells are protectively coloured like their background. They are found in large numbers living on rocks below and above the high tide level, and they are also found living in the estuarine regions. The peculiarity about these animals is that they are able to live a long time out of water. This semi-terrestrial habit has developed to such an extent in some species, that they may be found living so high on the rocks that they get only the spray of water at high tide.

Planaxidae:

Planaxis is usually found in large numbers along with *Littorina*, and they are almost similar to each other in appearance, but on closer observations the differences can easily be recognised between the two. *Planaxis* shell has a shorter spire, wider aperture and no umbilicus. There is a distinct spiral ridge extending inwards from the inner side of the posterior canal, and the columella lip is broad.

Cerithiidae:

The shells have an elongated spire having many whorls marked with tubercles. The aperture of the shell is strongly channelled and the operculum is horny.

Cerithium is quite common in the backwaters along with *Cerithidea* (Potamididae), but they are few in number. It not only has the same habitat but also closely resembles *Cerithidea* in size and sculpture. *Cerithium* differs from it in being slightly more slender and having an additional ridge on the two lowest whorls.

Vermetidae:

Vermeteus has been collected in Kamat's Bay and Binge Bay. The whorls of the shell are not fused and it appears like a worm-tube. The shells are always attached to rocks. Their foot is reduced to a vestige, supporting only the horny operculum. Specimens of *Vermeteus* at Karwar, however, have their tubes coiled in one plane, unlike those described by Gravely (Madras).

Turritellidae;

Turritella shells are long, heavy and gradually tapering towards the apex with transpirally ribbed whorls. The foot is broad, truncated and provided with a horny operculum.

Turritella acutangula (Linnaeus) is the most common species found living at moderate depths in muddy sands. Both animals and empty shells have been collected in large numbers on the beaches. The largest specimen collected is about six inches in length. Sea-anemones (*Sagartia*) are sometimes found attached to empty shells buried in the sand.

Strombidae:

All Strombidae shells have a well-developed shell. The outer margin of the aperture has a tendency to grow into wing-like or finger-like expansions. Their foot is narrow, arched and adapted for leaping movements, and they bear a sharp claw-like operculum.

Strombus has a shell with the outer lip shaped like a wing. The rapid jerky movements of the clawed foot is dangerous to those who handle it carelessly. These animals live in shallow waters in muddy sands.

Rostellaria has a large shell with a long tapering spire which is finely polished. The outer lip expands into a wing and its anterior end is produced into a long and narrow beak. They are supposed to be found in abundance at depths between 10 to 30 fathoms. Only a few empty shells have been collected.

Hipponycidae:

Hipponyx has a bowl-shaped shell with three distinct ribs radiating from the apex. Several white shells have been collected from the shores of Anjidiv Island, Kamat's Bay and Karwar Bay. It is said that these animals live on the rocks of the West coast of Anjidiv island, which was not investigated.

Calyptraeidae:

Calyptraea (*Crucibulum*) *extinctorium* (Lamarck) is the common species of Karwar of which, many shells have been collected from several localities. The shell is thin and conical with a spiral apex, on the inside of which, can be seen a small curved ribbon-shaped plate. Living specimens attached to bivalve shells (*Paphia*) have been collected in the dredge in Karwar Bay.

Naticidae:

Naticidae are active sand-burrowing gastropods with a large foot whose outer parts are folded over the head, thus forming an efficient plough to burrow into the sand. Three genera are represented in Karwar.

Natica have thick shells with the body whorls bulged to such an extent that some forms look like *Pila* (Ampullariidae). The columella lip is more or less thickened. These animals are very common and are found in large numbers in the mud-flats of the estuary and backwaters. Their egg-masses are very peculiar and have been observed in large numbers. Thousands of minute eggs mixed with sand and sticky secretion, arranged to form soft spiral ribbons and standing out as little truncated cones, are common objects seen on muddy flats in Karwar.

Eunaticina have shells with a high spire and a straight columellar lip. Only a few dry shells have been collected on the shores.

Albula has a heavier shell with the body whorl oblique and less inflated. The umbilicus is completely closed by callus. A few worn-out shells have been collected.

Janthinidae:

Janthina is pelagic, living in the open sea. Their empty shells are often seen cast upon the beaches. The shell is thin and violet tinted, with no columella and umbilicus.

Cypraeidae:

Cowries have massive oval shells with an arched top and a flat base. The spire is not visible and the aperture is a toothed slit in the middle of the flat base. The foot is large without an operculum. The mantle, when expanded, can cover the shell and thus retain its polish. Several species of *Cypraea* are known in Karwar, of which *C. moneta* (Linnaeus) is quite common living on rocks between the tide marks. Their shells have a central elevation with yellowish colouration.

Cymatidae:

Cymatium is the only genus known in Karwar. The shell is thick with a well-developed spire and has uniform spiral grooves. The anterior canal is slightly elongated and the operculum is horny. A single specimen has been collected in Baitkal Cove,

Ficidae:

Ficus is represented in Karwar only by two or three empty shells collected on the shores. The shell is long, pear-shaped with a low spire and a large body whorl. The operculum is absent.

Bursidae:

Bursa granularis (Roding) is a common form found in the shallow waters of Baitkal Cove, Kamat's Bay and Karwar Bay. They live as scavengers feeding on the debris of muddy bottoms. The shell has a stout varix continuous along the whole length of either side. The remaining space of the shell surface is decorated with spiral lines of tubercles.

Potamididae:

The shells have elongated spires with numerous whorls either tuberculated or spirally ridged. The aperture of the shell has a short anterior canal and the operculum is horny. The following three genera are represented in the backwaters of Karwar: *Cerithidea*, *Telescopium* and *Terebralia*.

Cerithidea (*Potamides*) is probably the most abundant gastropod, found on the mud-banks of estuarine regions and back-waters. Their shells are small with each whorl ornamented by three transpiral ribs bearing tubercles. They have been observed in very large numbers in Chendie Creek and Kalinadi estuary. Among the specimens collected there are several species belonging to this genus.

Telescopium is easily recognised by its large shell (about four inches in length) and smooth whorls with faint ridges. A number of them have been collected on the mud-banks of the river Kalinadi.

Terebralia has also a large shell with broad spiral ridges and transpiral ribs, which are more or less distinct at least towards the apex. Only a few slightly worn-out shells have been collected from Mavin Halla area.

Eulimidae:

A single dry shell of *Eulima* has been collected in the Kamat's Bay. The shell is small, very slender with a tall spire and the whorls are not inflated. The surface of the shell is smooth and glossy.

Bullidae:

This family is represented only by the empty shells of *Bulla* which are usually washed ashore. It is a swollen oval shell, purplish-brown in colour. There is no spire and the aperture is broad in front and narrow behind.

Cavoliniidae:

These are small pelagic molluscs with two forms represented in Karwar. A few empty shells of *Cavolina* were found washed ashore in Kamat's Bay. The shells are thin, small, broad and pocket-shaped. The other form has a tubular shell, resembling *Creseis* in many respects. It has been observed in the plankton very often. Their foot is divided into two lateral fins. Many a time these tiny shells are also washed ashore.

Aplysiidae:

These animals are soft-bodied and lumpy, with a large foot. They possess a thin transparent shell covered by the mantle. Two representatives are found in abundance in Karwar.

Aplysia are dirty green in colour with brown spots and grey blotches all over the body. In Karwar, they have been collected in enormous numbers in Baitkal Cove, only during the months of December and January. They are found in muddy areas among the green seaweeds (*Ulva* sp.). Eggs of *Aplysia* are laid in long strings made of a jelly-like substance, and are found in masses of coils among the green seaweeds, in the same area and during the same season.

Bursatella (*Notarchus* Hornell) is smaller than *Aplysia* and the body is beset with small branched filaments. The shell is extremely small and internal. The lateral flaps of the foot are fused over the back posteriorly and not open like that of *Aplysia*. On the sides of the body are found some eye-like bright green spots with a brown ring. These animals have been collected in large numbers from the same locality as *Aplysia* and during the same season. They have also been collected in Mavin Halla area.

Doridiidae:

A single specimen of *Doris* has been collected in Baitkal Cove. It is greenish-yellow in colour with dark tubercles all over the body. The gills are external and form a circlet round the anus.

Another nudibranch, which is probably included in this family, has been collected from the rocks in Kamat's Bay. It is a soft-bodied pink coloured animal living attached to rocks between tide marks (*Dendrodoris* ?).

Aeolididae:

A single specimen of *Aeolis* has been collected in Karwar, which was about an inch in length. It is a cream coloured, elongated, soft-bodied nudibranch with numerous cerata covering up the lateral aspect of the body.

Hervia, another nudibranch belonging to this family, is found on the rocks among sea-anemones and hydroids in Kamat's Bay. It is a

beautiful pale pink-coloured animal about the same size as *Aeolis* and bears bright orange-coloured cerata, which are arranged in a series of tufts on either side of the body.

Arminidae :

Armina (*Pleurophyllidia* Meckel) was collected in large numbers on the Karwar beach only once (December 1945, at dusk on a full moon day). They were stranded on the shore by the action of the waves, where they remained motionless for a while and then burrowed into the sand. They have a soft flat body, oval in shape, and pale brown in colour with numerous white spots on the dorsal side. The, foot is long and bears rows of branchiae on either side.

Onchidiidae :

Onchidium, which is the sole representative of this family, is quite common in Karwar. It is a slug-like gastropod with a leathery skin bearing warts on the back. In addition to the eyes at the tip of the tentacles, many eyes are present on the warts. These animals are found in mud and on stones in the brackish water areas near the mouth of the river Kalinadi. A number of specimens have been collected.

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(*To be continued.*)